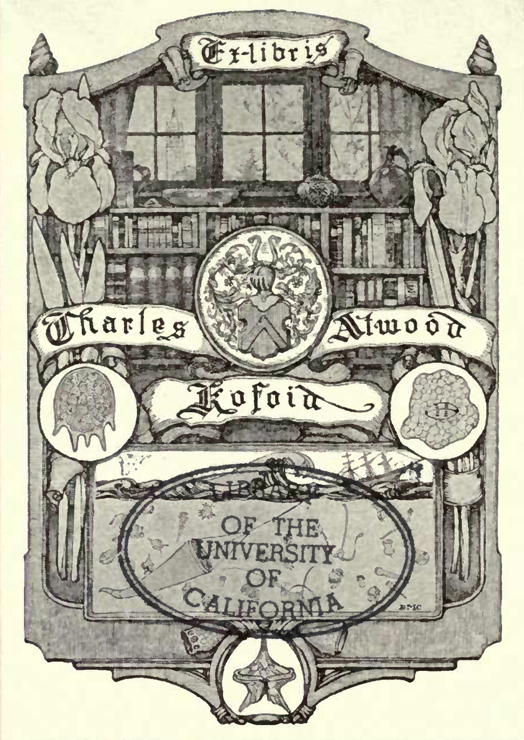
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TIDES.

New Theory

BY

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BOSTON:
RICHARD L. GAY & CO., PRINTERS, 63 MILK STREET.
1871.

TIDES.

NEW THEORY.

PREFACE.

As the common theory respecting the tides is not entirely satisfactory to all who have given the subject consideration, I wish to present some new views, which I trust will receive the attention of those who are interested in this subject.

More than two years ago I hastily prepared and published a few circulars, explaining briefly my views, hoping that even from so crude a paper, some one would be induced to adopt the chief idea, and demonstrate it in such manner, as to make it clear and convincing. All I have heard from those circulars, is by several letters received from distinguished men, most of whom gave encouraging and approving replies, but they had not given the subject sufficient study to enable them to speak with confidence. Since that time, though I have not had a doubt as to the correctness of the main principle, I have changed some of my views relative to the manner of producing certain results, and have by further contemplation of the subject acquired some additional ideas. I will not now pretend that my notions are correct as to the manner certain movements and conditions of the water are brought about, but I rely upon the main idea of lateral movement, and will again hope I may say enough to induce competent minds to examine the subject thoroughly.

THEORY.

THE tides are caused by the moon's attraction, causing a movement of the waters on that part of the surface of the earth where they can move horizontally towards the moon; that is, the greatest effect is produced on a belt of water surrounding the earth where a line from the moon meets a line from the centre of the earth at right angles, though the influence extends—its effect diminishing each way from this belt—(that is, nearer to and further from the moon,) many leagues, probably many degrees. But the moon's attraction has no effect upon the waters on that quarter of the earth nearest the moon, because the earth's vastly greater attraction is there in opposition to the moon's; nor does it affect them on that quarter of the earth furthest from the moon, because the moon's attraction is there in conjunction with the earth. It is upon the sides, or outer rim of the earth, as seen from the moon, where the slight —and in all other respects, imperceptible—attraction has its effect upon the waters and moves them, because the earth's attraction there offers little or no resistance to their movement.

It is the common experience of all that water is agitated, and moved horizontally, by the slightest force. A pebble dropped into the centre of a pond, will make a perceptible movement of the whole surface water. Moderate winds roll the surface water of the ocean into waves. Great rivers flow freely towards the ocean, where the descent is only one inch to the mile. Thousands of tons of water can be moved horizontally, by a force which would be insufficient to raise one pound perpendicularly. The earth holds the air and water to herself, but allows them to be moved horizontally by the least force; and the same may be said of solids when there is no friction or other hindrance. For instance, take a perfectly round and polished glass ball, upon a water level polished glass surface; a very slight force would put this ball in motion— even the feeble attraction of the moon would start it, if the ball was situated on that part of the earth's surface where the moon's force would draw at right angles to the earth's force, and probably the ball would roll towards the moon many degrees (theoretically perhaps to the very point nearest the moon), but when the earth's greater attraction came in direct opposition to the moon's, of course the moon would cease to have effect.

Let us suppose the whole surface of the earth covered with water— the earth not revolving on her axis, nor the moon revolving around the earth; and suppose the moon's attraction just now, for the first time applied. Where shall we look for the first motion in the heretofore calm waters? Certainly not directly underneath the moon, nor on the side opposite, but on that belt of water surrounding the earth, 90 degrees distant from the

point nearest the moon. There the earth's attraction permits it, and we can imagine the water slowly sliding towards the moon, particle making way for particle, and quantity for quantity, until a movement be given to a belt of water many degrees broad, slightly elevated in front and slightly depressed in rear of the movement; so if the earth and moon were to retain their supposed conditions, the water would in time—perhaps in a few months—come to rest somewhat elevated above its former level on that quarter of the globe nearest the moon, and equally depressed on the opposite quarter. But the supposed condition is not the real one,—the earth and moon do revolve, and those waters which are now in position to be moved by the moon's attraction, are carried forward nearer the moon on the westerly side of the earth, and back farther from her on the easterly side, the moon's attraction gradually losing its effect upon them; while at the same time other waters are brought to the sides or circle where the moon's effect is greatest. Thus are they kept in motion, those in low latitudes moving easterly on one side, and westerly on the other side of the earth, while those in high northern latitudes are drawn southerly and westerly and southerly and easterly; and those in high southern latitudes are drawn northerly and easterly and northerly and westerly.

In low latitudes the waters which are now moving eastward, will continue in that direction until they have passed under the moon, and on to the eastward to the point where they are checked by the moon's attraction in the opposite direction. There they will come to a stand, and will be gradually turned into a westerly current. So the westerly current continues to flow westerly until it passes the meridian on the opposite side from the moon, when it is gradually checked by the eastward attraction, and turned into an easterly movement.

These, I conceive, would be the movements of the waters, which the moon's attraction would cause, provided the earth was entirely covered with water, as I have thus far considered it.

But the continents and islands cause very different movements from what we should expect if there were no obstructions. Currents are found moving in every direction, with various degrees of velocity, and the rise and fall of tide on the shores of different continents and islands, varies from a few inches to fifty or sixty feet.

If my idea as to the eastward and westward movements be correct, there can be but very little rise in the unobstructed ocean waters,—possibly not more than two inches above the mean level. Hence we should conclude, that the high tides we find on our coasts, are caused by the checking of these movements, whereby the waters are heaped up many feet deep, on the shores, and in the gulfs and bays. It must be evident, also, that these heaped waters are gradually sloped off, so they extend only a comparatively short distance from the shore.

The amount of tide at one place may be caused by the direct movement following the moon. At another place it may depend upon the direct movement, and an indirect movement, which indirect movement was started many hours before the direct one; and at another place it may depend upon the same combination, assisted by a reacting movement. In all cases the rise depends much upon the shape of the coast to which the movement comes.

The size of the tide is very different in places which are only a few miles apart. For example, the range in some places on the Southern coast of Ireland is only three feet, while just across the Bristol Channel the range is very high, being in some places more than sixty feet. In this instance the tide movement comes probably from the west or south-west—passes parallel with the south end of Ireland, and is crowded directly into the tunnel-shaped Bristol Channel, where it is heaped up. This and many other examples of the tide being very high in some places, while it is very little in other places not far off, prove that the tide is caused by stopping the movement of the water, rather than by a general rise of the ocean.

It will be seen that, as the moon influences a broad belt of water, encircling the earth and including the polar regions, the waters of high latitudes are, to a greater or less extent, constantly affected by the moon's attraction; while those near the equator are not affected at all when they are directly under the moon, or when they are on the opposite side from the moon. Nor, is the moon's influence at any time so great upon them as it is on the waters of higher latitudes, because the greater velocity of the revolving surface at the equator, gives less time for the moon's attraction to create a movement of the water. So this theory leads us to believe that we should have the highest tides in high latitudes, and so we find it, in fact.

I have thus far spoken of the moon as causing the tides. The sun exerts an influence in the same manner, and makes his tides; but his effect upon the water is so much less than the moon's, his tides are recognized only as increasing or diminishing the moon's tides. It will be apparent that, when the sun and moon are on the same side of the earth, each moving the same waters in the same direction, we should have, as we do, the high run of tides, or spring-tides. I think it will also be evident, that when the sun and moon are ninety degrees apart, that is,—when the moon is making her tides in two opposite quarters of the globe, and the sun is making his in two intermediate quarters, we should have, as we do, the low run of tides, or neap-tides. It is known that spring-tides occur again when the sun and moon are on opposite sides of the earth. This may not seem to coincide with my main idea, that the tides are made by a movement of the waters towards the foreign attractions, because in this case the sun and moon attract in opposite directions. I will not pretend to be confident as to the mode by which the spring-tides are formed when the earth is between the sun and moon. It may be owing chiefly to the near approach of the moon to the earth. But, supposing the earth covered with water, it will be seen, that while the moon creates a movement and slight elevation towards herself of the water where her lines of attraction are tangent to the earth's surface, the sun will create a lesser movement and elevation towards himself from the same waters. These two elevations will at one time be, perhaps, several degrees apart; but when, by the diurnal motion of the earth, they are carried away from the main influence of the attractions which formed them, they will react to fill up the depression which exists between them. This reaction and combination will cause an elevation greater than the moon's power alone could produce. Though this might be the effect if the earth was entirely covered with water, it may

be quite different under existing circumstances. The intervening land may in most instances prevent the combination being made as represented,—especially where the line of the coast is at right angles with the lines of attraction; but in those cases, the sun's attraction may augment the alternate or reacting tide. The idea of the tides being made by a movement of water towards a coast—the water being heaped by stopping the movement—would perhaps induce the thought that there would be no tide on a coast where the moon attracts the water away from that coast, instead of towards it. A second thought would lead to the conclusion that the reaction must be nearly equal to the direct flow following the moon. Suppose high water following the moon to be ten feet above the mean level of the ocean,—the force of that elevation would cause the water to recede and fall, so that near the shore, low water might be nine feet below the mean level. This depression would of course occasion a return of the water, so as to make the second tide nearly as high as the first, without the help of the moon's attraction. Under these circumstances, the sun being opposite the moon, will be in conjunction with the reacting movement, and will help to swell the alternate tide. In most instances, where the direction of the attraction is nearly at right angles with the line of the coast, the alternate or reacting tide will be increased by a tide-movement from the northward or from the southward—or possibly from both.

As we find the morning tides are not produced in the same way the evening tides are, we should not expect the two tides to be of the same size; and so it is found in most places they are not; nor is the interval from morning to evening tide the same as the interval from evening to morning tide.

On the western coast of North America the two daily tides are unlike, particularly so when the moon has large southern declination. I quote from the New American Cyclopædia: "High water occurring about twelve hours after the moon's transit, will mark five feet on a tide-staff." (This, we will suppose, is the reaction of the twelve hours' previous tide.) "Five hours afterwards," (this will be when the moon is seven hours to the eastward of that place,) "low water will mark three and one-half feet, six hours after which the second high water" (which is the result of the moon's attraction towards that coast,) "will mark seven and one-half feet, and seven hours later" (which is when the moon is six hours to the westward of that place,) "the second low water will fall to zero."

In this case there seems to be an agreement between the facts as reported, and the probable workings of the principles of this theory. At least, the facts are not inconsistent with the theory.

In the Gulf of Mexico the tides are similar to those of the western coast of America, though much smaller. I account for these tides by assuming that the tide movement which follows the moon westward across the Atlantic, continues its influence through the Straits of Florida, and so on, by the help of the moon, through the whole Gulf, thereby making one regular tide a day. Whereas, the reacting Atlantic tide, though it may be nearly as high at Cuba, will not extend far into the Gulf, because the moon, if she does not oppose, will not assist it. The smaller tides of the Gulf are probably caused by the attraction of the

waters of the Gulf alone. Those alternate small tides on the western coast of Florida, come of the easterly movement from the westerly side of the Gulf, which movement is not felt in the bend of the coast, between the Mississippi River and Cape St. Blass, where there is only one tide a day.

In the Mediterranean, there is a small tide at each end of that sea, while there is no perceptible rise in the middle. This may be accounted for by the easterly and westerly attractions making in the sea a slight movement, which, when checked by the land at the ends, raises observable tides. The small tide at the head of the Adriatic, which is not observable at the mouth of that sea, is due to the westerly movement, which starts from the easterly end of the Mediterranean.

One writer says: "The Indian Ocean appears to have high water on all sides at once, though not in the central parts at the same time." I will not be confident as to the manner of producing such a result; but it will be perceived that by this theory, it may be by the westerly movement which, coming from the Pacific, is checked by the East India Islands, and delayed in getting past them, so that, by the time the rise takes place on the westerly side of those Islands, the moon has passed along far enough to produce a tide on the easterly shore of Africa, by attraction of the waters of the Indian Ocean. Or, it may be the tides are made by direct movement on one side of the ocean, and by reaction on the other side. The fact stated, at least supports my idea that there is no considerable rise of water over a great extent of surface at the same time; and that, while it is high water near the shores, it may be low water not many hundreds of miles out in the ocean.

OCEAN CURRENTS CAUSED BY THE TIDES.

The direct tide movement I conceive to be very unlike the currents of the ocean. Currents may result from tide movements, but the tide is at first independent of all currents. The moon has the effect to set the whole body of water which she influences, over towards herself; eastward or westward, as the case may be—not materially changing the relative positions or movements of ocean currents, but operating alike, against currents, with currents, and across currents. When this great tide movement comes to the land, and the water is heaped up by the force of its momentum, it may in due time recede directly back the way it came,—or it may be thrown to the right, or to the left, according to the line of coast to which it comes. The water then assumes the nature of a current, instead of tide movement. For example, the eastward tide movement of the Pacific, which comes upon the western shores of North America, is thrown southeasterly, and produces a current parallel with the line of that coast. In this connexion I will advance the idea that the moon, by her attraction towards a coast, will bring more water to the coast, than she will by her reverse attraction take away from it. Her attraction does not make any considerable effect upon the water at once, nor until it has, little by little, changed the position of the particles over a long distance. Hence the approaching movement, initiated hours before, and extending thousands of miles back into the ocean, will bring near to the coast, a much greater amount of water than the reverse attraction, which has to initiate a new movement at the coast, will

take away. Therefore, we may presume that the water is continually higher near the continents, on both sides ot the Pacific, than it is in the middle of that ocean.

In support of these views, we find a constant current southeastward along the western coast of North America, transferring the heaped waters, from high northern latitudes, down within ten or twenty degrees of the equator—where they come upon the elevated water which seems to be held in the bend between the two Americas—and here they turn westward. We find a portion of the waters which are elevated on the western coast of South America, flowing constantly eastward past Cape Horn into the Atlantic; while another portion, combining with the current from the Antarctic, flows northward, until it is turned by the bend in that coast. It then flows westward, and at length joins the waters from the north. Thus a large portion of the water which is brought to the western shores of this continent by the moon's attraction, is concentrated near the equator, and carried away by a current. Thus also is established and maintained, the fountain head of that great equatorial current, which flows westward from America to the East Indies.

Now for the western side of the Pacific Ocean!

Here we find the tide waters of the north are thrown by the slant of the Asiatic shores, southwestward down to the East Indies, where they form a sort of barrier against the approaching equatorial current, and turn a portion of that current northward. That movement initiates the Japan Stream, which flows northeastward, emptying a portion of its waters through Behring Straits, into the Arctic; the balance flowing eastward, near to the American coast, and thence southeasterly, together with the tide waters of that coast, down again to the equator.

At the East Indies again, we find another portion of the equatorial current, joined with the elevated tide water, flows westward past the Islands into the Indian Ocean; while the southern portion of the great current goes southward past the east side of Australia, and there joining the northeasterly movement from the Antarctic, flows back to the western shores of South America, and thence northward to the equator again.

It will be seen that the shores washed by the North Pacific seem to be particularly adapted to turning the tide movement which comes to those shores, down towards the equator, while the shores of the South Pacific are not so favorable for turning the water northward. Hence more water is conveyed from the north down to the equator by the tide movement, than is conveyed northward to the equator from the south. Therefore more must be returned from the equator to the north. The great Japan Stream performs that service of returning the overdrawn balance to the north, and we find no great current southward.

In the Indian Ocean, the influx of the raised waters of the west Pacific, is felt by the current westward across the ocean ten to fifteen degrees south of the equator, or on the parallels of the main influx. On the western side of the ocean, this current, with the tide movement, makes a continual rise above the mean level on the east coast of Africa. This rise causes a constant current southwestward along that coast, and thence westward around the south end of Africa, into the Sonth Atlantic.

In the South Atlantic, the influx from the Indian Ocean is joined by the easterly influx around Cape Horn, and thus is created the reservoir of that great movement which goes through the Atlantic,—at first northward, nearly parallel with the southwest coast of Africa to the bend in that coast. Then westward, one portion going through the Caribbean Sea, and out between Cuba and Florida, while the other portion goes north of the Islands. The whole then moves northeastward—a large portion to the Arctic, supplying that ocean with an immense amount of warm water, in exchange for cold water and icebergs.

The exchange between the Atlantic and Arctic is apparent. But it seems doubtful how the Pacific and Indian Oceans get compensation from the Atlantic and Arctic. It is partly, no doubt, by an undercurrent southward through Behring Strait—and it may be partly by the difference in evaporation and rain-fall, or it may be by undercurrents in the South Atlantic.

I have thus mentioned the main currents of the oceans, with the idea that the reader will see the connexion they have with the primary movements which the moon's attraction causes; and that these currents, being due directly or indirectly to the tide movements, tend to substantiate my theory.

I would not deny that the trade winds have a tendency to guide the equatorial current—perhaps they accelerate its movements and augment its volume; but I believe it will, in time, be found that the concentration of the tide waters, near the west coast of Central America—as before represented—is the first cause, and chief support of that great current.

There is a current along the eastern shores of Asia, which runs southwesterly inshore of the Japan Stream. There is a current on the southwest coast of Africa, which runs southeasterly inshore of the great northward movement. There is also a current which runs southwesterly along the easterly coast of North America, inshore of the Gulf Stream. None of these inshore currents are supposed to be eddy currents. Now, I suggest that these facts support the idea I have advanced, that the water near the shores is kept above the mean level by the influence of the moon. I suggest, also, that these above-named inshore currents, as well as the currents on the cocst of California, on the coast of Brazil, and on the eastern coast of Africa, confirm the statement that water moving against a shore which lies diagonal to the course of the movement, is thrown obliquely parallel with the line of the coast. These currents prove also, that the tide movement comes from the westward as well as from the eastward.

FOUNDATIONS OF THE TWO THEORIES.

The common theory teaches that the waters nearest the moon, being attracted with more force than the centre of the earth, are drawn away from the earth, while the centre of the earth, being attracted with more force than the waters furthest from the moon, is drawn away from those waters. That theory also gives as a reason why the moon has greater influence in producing tides than the sun has; that the relative difference in the distances between the moon and the different portions of the earth, is greater than the relative difference between the sun and the different portions of the earth.

As my theory teaches that the foreign attractions cause the tides by lateral movement, and therefore the difference in the distances has no part in the matter, I shall be expected to state what I have for a foundation to my theory,—why the water is moved more than the earth, which is equally distant from the moon, and why the moon has more influence on the water than the sun has.

The law discovered by Newton, is as follows: "Every particle of matter in the universe, attracts every other particle of matter with a force or power directly proportioned to the quantity of matter in each, and decreasing as the squares of the distances which separate the particles increase."

I am not competent to make the mathematical calculation which will determine whether or not my theory will stand the test of this law, but when a trial shall be made, taking a portion of the ocean water instead of the whole earth, as one of the quantities in the calculation, I have no doubt the result will be favorable, and that a solid basis will be acknowledged for a theory which appears plausible.

I cannot now do more than to give my own views in my own way.

Suppose the earth annihilated, leaving a cannon-ball in its place, would not that cannon-ball tend to go to the moon?

Now, suppose the solid portion of the earth taken away, leaving the water in its stead, would not that water fall to the moon, or, possible, revolve around her the same as the moon now revolves around the earth?

If these questions admit of affirmative answers, then it follows that the moon will attract the waters on the face of the earth more than she will the solid earth, wherever the waters can be moved as an independent quantity, or without hindrance by the earth's attraction; and I contend that they can be moved on the ninety degree circle much the same as if they were floating in space uninfluenced by the earth. Let us take the sun's influence on the moon revolving around the earth, as analogous to the sun and moon's attraction of the waters.

When the moon is receding from the sun on one side of the earth, her progress is retarded by the sun's attraction;—when she is approaching the sun on the other side of the earth, her progress is accelerated by his attraction. Now we will consider the water as revolving around the centre of the earth, 4,000 miles distant therefrom, the same as the moon revolves 240,000 miles distant. When the water is receding from the moon or sun on one side of the earth, its diurnal progress is retarded, and when it is approaching on the other side, its diurnal progress is accelerated. In either case the water is made to move over the face of the solid earth, and *this* is the movement which makes the tides.

If it be conceded that in case the solid portion of the earth was taken away, leaving the waters alone, they would first go to the moon, then, of course, the moon must have the greater influence in producing tides. The moon's nearness, as compared with the sun's, and her great mass as compared with the particles of water, makes her effect on those particles the greatest, notwithstanding the sun's attraction on the whole earth is far greater than the moon's.

In a system of revolving bodies, distance, weight and velocity are to be considered. At a given distance from the great centre, if a revolv-

ing body be reduced in weight, velocity must be added, or the reduced body will tend to the centre, and go to it, or move in a new orbit. Leave the weight unchanged—and reduce the velocity—the result would be similar. Leave the weight and velocity unchanged, and reduce the distance, the result would be similar. On the contrary, if. at a given distance, the weight be increased, velocity must be reduced, &c.

Now, it is evident, that if the solid earth were stricken out, leaving the water, or a small part of the water, moving at the same rate the moon now moves around the earth, the water having so little weight would need greater velocity, or it would not keep its present distance from the moon, but would tend to go to it; hence the tendency in that direction where it can move without the earth's hindrance.

RESPECTING THE COMMON THEORY.

As my theory must be false if the old be true, I must attempt to show that the old theory is false.

If I may be considered presumptuous in attempting to refute opinions of the most celebrated scientific men, I shall at least be countenanced by many, in saying that the common theory of the tides impresses the common mind unfavorably; and as I am one the unbelievers in that theory, I should be permitted to give some of the reasons why I am so.

That theory represents that there exists continually, two "immensely broad and flat" protuberances of water on two opposite sides of the globe; one protuberance being raised by the amount of attraction which the moon has on the near waters more than she has on the centre of the earth, while the other is raised by the amount of attraction which the moon has on the centre of the earth, more than she has on the remote waters. In short, the water is drawn away from the earth on one side, and the earth is drawn away from the water on the other side.

It certainly appears as though the remote tide could not be made as represented, for, in *fact*, the earth is not moved by the moon in the least degree, excepting as she is swayed a little by the moon's revolution around her. And as this revolution is made only once in twenty-nine days, it would seem that the only chance for the moon to make a tide by drawing the earth away from the remote waters, would be, to stop the earth's motion on her axis, and have only the two tides in twenty-nine days; or, if we would have two tides in a lunar day, the moon should make twenty-nine revolutions while she now makes but one.

I cannot conceive how these immensely broad elevations, which are said to exist at all times, can follow the moon from east to west; nor can I conceive how they can be made to appear on the easterlv sides of the oceans, and disappear on the westerly sides. Let us suppose the vertex of one elevation is now in the middle of the Pacific, moving westward at the rate of 1,000 miles per hour. It must at the same time be about low water at the Isthmus of Panama, and also at the East Indies. In six hours the top of this immense wave will be at the East Indies, and make high water there. In six hours more, the wave will have disappeared, and again it is low water. Now, I ask, where has this great wave gone to, in the short space of six hours? Certainly not back eastward, for the opposite wave has meantime appeared on the eastern side

of the ocean, and has followed right on, so it is now in the middle of the ocean. In fact, that theory does not indicate that the tide wave ever goes eastward. It cannot be said that it passed through the straits of the East Indies, because an amount of water equal to a rise of six inches over so great an area, could not pass through those straits in many months. But the disappearance of the wave on the western side, is not more strange than the formation of another on the eastern side of the ocean. Where has the vast amount of water which has raised the eastern Pacific from low water to high water come from? As soon as one wave passes westward out of the way, another springs up and follows, and so they go forever; still, there is no *less* water on the American side, and no *more* on the Asiatic side. Let us see how it is in the Atlantic Ocean. As there is but little breadth here for the slope of the tide wave east and west, we should be led by that theory to infer, that at high tide the whole ocean would be raised as much as the average depth of the tide on the shores. This would be at least two feet. To say nothing as to where this vast increase of water comes from, is it possible to tell how it can escape, so as to make low water, in six hours' time? It cannot go eastward,—it cannot go westward, unless it goes under the American Continent; for the current is always eastward off Cape Horn, and much of the time southward in Baffin's Bay.

I know the supporters of that theory instruct us that the tide protuberances are raised,—not by a transfer of the same particles or quantities of water,—but by an undulating motion—a sort of rising and sinking of the particles. One writer says: "The tidal wave is entirely different from a current; the particles of water merely rise and fall." The action may be different from a current, but if there be a rise of one foot or one inch of water on a certain area, the amount of that one inch or one foot rise, must be added in some way, and must come from some other locality. We may conceive how the common small waves of the sea may be kept in existence and in motion, by the sinking of a quantity of water, which may at one instant constitute a wave, and the consequent forcing or wedging up of another quantity just in front, and this last quantity again sinking, and another rising, and so on; thus advancing the whole surface water a little, without much changing the location of any particular quantity of water. But it appears impossible to understand how a quantity of water which raises an "immensely broad and flat wave," covering one-quarter of the globe, can, by this rising and sinking process, be moved over the face of the earth at the rate of nearly one thousand miles per hour, even if there was no land to obstruct its progress. Admitting, however, that this undulating motion can in a few hours sink the surface of the whole eastern Pacific from high to low water, and raise the surface of the whole western portion of that ocean from low to high water, is it possible for that sinking and rising process to continue its influence through the straits at the East Indies, so as to sink the western Pacific and raise the Indian Ocean in a few hours more?

If there are reasonable explanations to these apparent mysteries, I have not been able to see them.

If the protuberances exist, as represented by that theory, the tides should be highest in low latitudes, for the elevations must slope from the vertices each way, north and south, as well as east and west. On the

contrary, we have the published statements to show that the average rise and fall is more in high latitudes than it is in low.

The fact that we have spring tides when the sun and moon are on opposite sides of the earth, appears to be inconsistent with that theory. For, though the moon, by her near approach, may raise more tide on the near side, how can she influence the earth, so as to make more tide on the remote side, while the sun at the same time is influencing the earth more powerfully in the opposite direction? How can each power increase the tide on the further side from itself, while the two powers are attracting the earth in opposite directions? In other words, can the earth be influenced in opposite directions at the same time?

The fact that there are tides at the extremes of large inland waters, while there is no perceptible rise in the middle of those waters, appears to conflict with the idea of two great general risings. The writer in the Cyclopædia says: "Near the east end of the Mediterranean, as at Malaga, a small tide is observable, being propagated from the Atlantic Ocean through the Straits of Gibraltar." Though I do not admit that the tide at the east end of that sea is propagated by the ocean tide, I quote the statement as supporting the theory of horizontal movement, and contradicting the theory of perpendicular rising. I ask, if a horizontal impulse or movement, given at the Straits of Gibraltar, will produce a tide at the east end of the Mediterranean, without making any apparent rise in the main body of that sea; may not a horizontal impulse or movement, given to the broad oceans, produce tides on the shores, without making any considerable rise in the main body of those oceans?

I trust I have not misrepresented the old theory. If, however, I have been led to my opinions respecting it, by not understanding the principles which determine those things, then the opinions can do no harm; for if the protuberances exist, and follow the moon from east to west,—they will continue to exist and follow, notwithstanding my objections.

In regard to my own theory:—If what I have said in my homely way shall engage the attention and consideration of scientific men, who will test the theory by sound principles, and by the facts as they exist, I shall have the strongest faith that the day will come, when the world will accept it as the true theory.

It will please me to hear from those who may be willing to express opinions, whether they approve or disapprove my views.

DANIEL K. CHASE.

CALAIS, MAINE, May 20, 1871.